PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : B41F 17/00 | A1

(11) International Publication Number: WO 97/27053

(43) International Publication Date: 31 July 1997 (31.07.97)

(21) International Application Number: PCT/US97/01283

(22) International Filing Date: 24 January 1997 (24.01.97)

(30) Priority Data:
08/599,513 26 January 1996 (26.01.96) US

(71) Applicant *(for all designated States except US)*: TETRA LAVAL HOLDINGS & FINANCE S.A. [CH/CH]; 70, avenue Général-Guisan, CH-1009 Pully (CH).

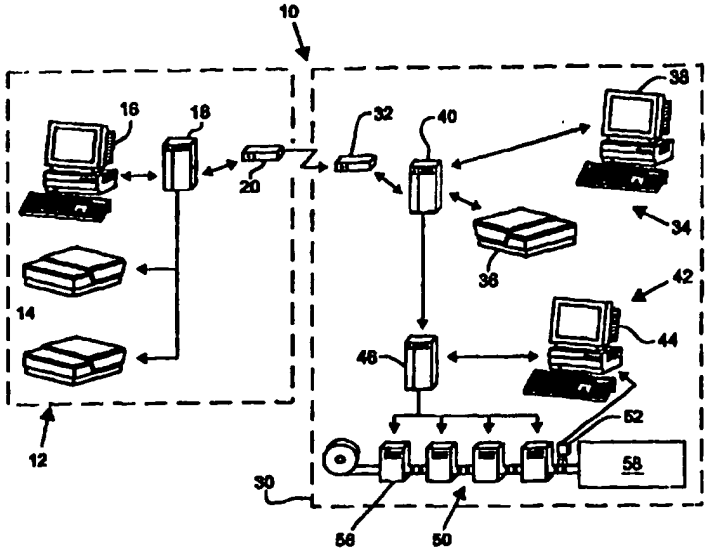
(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: JENNEL, Per [SE/US]; 2052 Lincoln Park West, Chicago, IL 60614 (US). ALBRECHT, Brian [US/US]; 549 Hill Terrace #303, Winnetka, IL 60093 (US).

(74) Agent: PODGORSKI, Annette, K.; Tetra Laval Services U.S.A., 1327 Barclay Boulevard, Buffalo Grove, IL 60089 (US).

(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: METHOD AND APPARATUS FOR PRINTING IMAGES ON PACKAGING MATERIAL



(57) Abstract

A method and apparatus for printing on packaging material (54) is provided in which an electronically storable and retrievable digital image is generated at a generating site (12), transferred to a printing site (30), and printed directly onto the packaging material (54) at the printing site (30). The packaging material (54) may be a carton blank, a PET bottle, or a laminated packaging material having at least one fiberboard layer. The digital images may be printed with an ink jet print head (52) that uses a UV-reactive ink.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	**GB**	United Kingdom	**MW**	Malawi
AT	Austria	**GE**	Georgia	**MX**	Mexico
AU	Australia	**GN**	Guinea	**NE**	Niger
BB	Barbados	**GR**	Greece	**NL**	Netherlands
BE	Belgium	**HU**	Hungary	**NO**	Norway
BF	Burkina Faso	**IE**	Ireland	**NZ**	New Zealand
BG	Bulgaria	**IT**	Italy	**PL**	Poland
BJ	Benin	**JP**	Japan	**PT**	Portugal
BR	Brazil	**KE**	Kenya	**RO**	Romania
BY	Belarus	**KG**	Kyrgystan	**RU**	Russian Federation
CA	Canada	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CF	Central African Republic			**SE**	Sweden
CG	Congo	**KR**	Republic of Korea	**SG**	Singapore
CH	Switzerland	**KZ**	Kazakhstan	**SI**	Slovenia
CI	Côte d'Ivoire	**LI**	Liechtenstein	**SK**	Slovakia
CM	Cameroon	**LK**	Sri Lanka	**SN**	Senegal
CN	China	**LR**	Liberia	**SZ**	Swaziland
CS	Czechoslovakia	**LT**	Lithuania	**TD**	Chad
CZ	Czech Republic	**LU**	Luxembourg	**TG**	Togo
DE	Germany	**LV**	Latvia	**TJ**	Tajikistan
DK	Denmark	**MC**	Monaco	**TT**	Trinidad and Tobago
EE	Estonia	**MD**	Republic of Moldova	**UA**	Ukraine
ES	Spain	**MG**	Madagascar	**UG**	Uganda
FI	Finland	**ML**	Mali	**US**	United States of America
FR	France	**MN**	Mongolia	**UZ**	Uzbekistan
GA	Gabon	**MR**	Mauritania	**VN**	Viet Nam

TITLE:

METHOD AND APPARATUS FOR PRINTING IMAGES ON PACKAGING MATERIAL

TECHNICAL FIELD

The present invention relates generally to printing images on packaging material, and specifically to generating and printing digital images onto packaging material.

BACKGROUND

Creators of packages and containers have provided their products with images since before history was recorded. However, from pre-Columbian pottery to polyethylene pouches, the process of creating and transferring imagery to containers has been labor-intensive, time-consuming, and wasteful of materials. This remains true despite the many changes that have taken place in the printing industry over the past decade.

The computer has been responsible for much of this revolution, particularly in the prepress industry. The influence of the computer was felt first in art creation, color separation, and proofing. As is evident from the ever-expanding arena of desktop publishing, many of these changes are still in progress, driven by the rapid advances made in the world of electronic communications.

Along with these changes, a peculiar imbalance has developed in the industry. While prepress operations in most firms were influenced dramatically by the advent of the computer, the pressroom has remained essentially undisturbed for years. In many printing plants, it has become commonplace to find the most modern technologies used to create artwork and even to process films and plates, while the package material printing process still employs plates or cylinders, press make-ready, printing and finishing operations that differed little from those in use for decades. Thus, packagers create and prepare artwork on computers, often in a matter of hours, only to end up using the same printing equipment and techniques known to their grandparents. These processes often take weeks to complete, consuming vast amounts of labor and nergy whil generating mountains of waste.

Concurrent with, but largely independent of, this revolution in artwork preparation, market pressures in the computer industry have resulted in the rapid development of new printing devices. Among these new devices are digital, non-impact printers using laser jet or bubble jet technologies, which have become commonplace in even the smallest offices. Despite their widespread acceptance in a variety of environments, these technologies have yet to be applied in an effective way in the production of printed substrates, such as packaging materials.

In the packaging industry, the most commonly used printing techniques are gravure and offset. In a typical gravure printing process, it is not unusual for five to nine weeks to pass between the time of creation of original artwork until packaging material delivery to the customer. The gravure process can generally be described as follows. Once the packaging producer receives the artwork, it must be checked. Next, separations and bromide proofs are made and checked, then forwarded to the customer for approval. Once the bromide proofs are approved, the producer generates a lithographic, or "litho", proof, which is again checked and sent to the customer. After the customer approves the litho proof, the package producer makes cylinders, then runs and checks cylinder proofs, and sends them to the customer for approval. If the cylinder proofs are acceptable, the press is prepared and set up. With the press set up, packaging material can be run, and subsequently delivered to the customer.

The offset process, while typically requiring somewhat less time than gravure, is similarly complex and time consuming. Once the packaging producer receives the artwork, it must be checked. Next, separations and match proofs are made and checked, then forwarded to the customer for approval. Once the match proofs are approved, the producer generates a litho proof, which is again checked and sent to the customer. After the customer approves the litho proof, the package producer exposes and develops plates, which are then mounted on the press. Next, the press blankets are cleaned, the press is set up, and the inks are balanced. The press is then ready for packaging material to be run, and subsequently delivered to the customer. The entire offset process often consumes from two to seven weeks.

Thus, it can be seen that, while electronic prepress has developed and become accepted as the norm in the production of packaging material, the development of suitable printing systems has lagged behind. It would be advantageous to provide a package mat rial printing system using lectronic printing techniques to print directly on to the desired substrate, thus reducing the number of steps from creation of a design to production of material,

while reducing pr press work and eliminating vast amounts of waste. Such a system would increase productivity due to drastically reduced order-change and set-up time.

SUMMARY OF THE INVENTION

The present invention provides a method and apparatus for printing package material that eliminates or ameliorates many of the drawbacks of previously known systems. In an embodiment, a method of printing on packaging material is provided in which an electronically storable and retrievable digital image is generated. Next, the digital image is transferred to a printing site. Finally, the digital image is digitally printed directly onto packaging material at the printing site. The step of digitally printing the digital image directly onto packaging material can include digitally printing the digital image directly onto a preformed bottle, such as a PET bottle. Alternatively, the step of digitally printing the digital image directly onto packaging material can include digitally printing the digital image directly onto a carton blank, or onto a web of packaging material, such as a laminated packaging material having at least one fiberboard layer.

The step of digitally printing the digital image directly onto the packaging material can include jetting ink through an inkjet printhead onto a surface of the packaging material. The ink can be provided as a UV-reactive ink, in which instance the UV-reactive ink, after the step of printing, can be cured by exposure to UV light or an electron beam. It is also contemplated that the surface of the material could be treated prior to printing. Common surface treatment techniques include flame treatment, corona treatment, and plasma jet treatment.

It is contemplated that a package forming system could be provided at the print site, and that the printing step could be performed substantially concurrently with forming a container with the packaging material at the print site. In this regard, the step of digitally printing the image substantially contemporaneously with the step of forming a container with the packaging material at the print site could include digitally printing the image adjacent to a form-fill-seal packaging machine forming part of the package forming system. In an embodiment, the step of digitally printing could be performed within a form-fill-seal packaging machine.

The step of transferring the digital image to a printing site can include electronically transmitting the digital image to the printing site, e.g., via telephone modem.

The present invention provides an advanced level of automation, with minimum operator intervention. The end product of the prepress area is transmitted in electronic form directly to a electronic printing pr ss, thus eliminating traditional labor-intensive prepress operations and materials. Equally important, makeready and paper waste on electronic printing presses represent a small fraction of the corresponding costs in traditional printing operations.

Other objects and advantages of the present invention will become apparent upon reference to the accompanying description when taken in conjunction with the following drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a schematic view of an electronic printing arrangement embodying the present invention.

FIG. 2 illustrates a schematic view of an exemplary printing arrangement.

FIG. 3 illustrates a schematic view of another exemplary printing arrangement.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As can be seen in Fig. 1, a printing system 10 for printing on packaging material is provided. An electronically storable and retrievable digital image is generated at an image generating site 12. The generating site 12 can be, for example, a commercial design studio having apparatus such as scanners 14, a desktop computer 16, and a digital storage device 18. The image generating site 12 is provided with a generating site data transfer device 20 capable of transmitting digitally-generated images electronically. It is contemplated that the generating site data transfer device 20 could include a telephonic modem or other electronic transfer medium, or could alternatively include some combination of electronic and physical transfer.

The printing system 10 further includes a print site 30. The print site 30 includes a print site data transfer device 32 capable of communication with the generating site data transfer device 20. The print site data transfer device 32 is itself in communication with a print site image processing arrangement 34. The processing arrangement 34 can include, for example, a scanner 36, a desktop computer 38, and a storage device 40.

The image processing arrangement is connected with a print control arrangement 42, which can include a CPU 44 and memory storage device 46. The control arrangement 44 is adapted to selectively actuate and monitor a material printing apparatus 50. The printing apparatus 50 includes a digital printhead 52, located in proximity with a supply of packaging material 54, as will be described in detail hereinbelow. The printing apparatus 50 may be provided in conjunction with a material processing line 56, which may include such apparatus as flame, corona, or plasma treatment devices, extruders, etc. The printing apparatus may also be provided in proximity with, or as part of, a form-fill-seal machine 58, in which packaging material is formed into a container, filled with product, and sealed.

Fig. 2 illustrates a particular printing arrangement 60, in which graphic information is printed onto packaging material in the form of a finished container 62. The container 62 may be provided as a preformed bottle, such as a PET or HDPE bottle, or as a container made from a laminated web, such as a fiberboard laminate. The printing arrangement 60 includes a digital printhead 64, which may be provided as an inkjet printhead. One suitable printhead is Spectra model 160-600-4. The printhead is in fluid connection with an ink supply 66. It has been found that UV-reactive inks are particularly well-suited for packaging material. Acceptable inks include cyan U1670, magenta U1688, yellow U1647, and black U1669 manufactured by Coates. A curing device 68 is located in proximity with the printhead 64. Freshly printed packaging material is exposed to the curing device 68 in order to cure the printed inks, rendering them fixed and scratch-resistant. The curing device 68 may be provided, for example, as a UV source or electron beam device. A suitable UV source is an ultraviolet lamp such as Fusion model F 300.

In operation, graphic designers at the image generating site use the various image generating apparatus to produce a digital image intended for packaging material. Next, the digital image is transferred, via the generating site data transfer device 20 and the print site data transfer device 32, to a printing site. Any on-site alterations are made electronically at the print site image processing arrangement 34, using the scanner 36, desktop computer 38, storage device 40 as necessary.

The print control arrangement 42 then selectively actuates and monitors the material printing apparatus 50 to apply the digital image to the packaging material.

FIG. 3 illustrates an alternative print arrangement 80 suitable for packaging material having irregularly-shaped or heavily-textured surfaces. The print arrangement 80 includes an inkjet printhead 82 similar to that shown and described with reference to FIG. 2. However, rather than printing directly onto the packaging material 84, the printhead directs ink to a pad 86 covering an offset roller 88. Ink is then transferred from the pad 84 to a surface 88 of the packaging material. This arrangement eliminates potential distortion that may be introduced due to ink from the printhead striking an irregular surface.

The present invention permits on-demand, high-quality printing for a wide variety of potential uses in the packaging industry. It is contemplated that the invention can be used to print complex graphics onto a moving web of material, onto carton blanks, or onto finish d

containers such as bottles or cans, with suitable inks individually matched to the materials and to the demands of the marketplace. The present invention offers the opportunity to eliminate traditional labor-intensive pre-press operations, as well as the need for plate and film materials, and to greatly reduce the need to maintain standing inventories of printed packaging materials. Due to the versatility of digitally stored and printed imagery, package designs and information can be stored in computer memories, retrieved, and customized for on-demand production.

Although the present invention has been described with reference to a specific embodiment, those of skill in the art will recognize that changes may be made thereto without departing from the scope and spirit of the invention as set forth in the appended claims.

WE CLAIM:

1. A method of printing on packaging material comprising the following steps:

generating an electronically storable and retrievable digital image;

transferring the digital image to a printing site; and

digitally printing the digital image directly onto packaging material at the printing site.

2. A method according to claim 1, wherein the step of digitally printing the digital image directly onto packaging material comprises digitally printing the digital image directly onto a preformed bottle.

3. A method according to claim 2, wherein the step of digitally printing the digital image directly onto a pre-formed bottle comprises digitally printing directly onto a PET bottle.

4. A method according to claim 1, wherein the step of digitally printing the digital image directly onto packaging material comprises digitally printing the digital image directly onto a carton blank.

5. A method according to claim 1, wherein the step of digitally printing the digital image directly onto packaging material comprises digitally printing the digital image directly onto a web of packaging material.

6. A method according to claim 5, wherein the step of digitally printing the digital image directly onto a web of packaging material comprises digitally printing the digital image directly onto a web of laminated packaging material.

7. A method according to claim 6, wherein the step of digitally printing the digital image directly onto a w b of laminated packaging material comprises digitally printing the digital image dir ctly onto a web of laminated packaging material having at least one fiberboard layer.

8. A method according to claim 1, wherein the step of digitally printing the digital image directly onto the packaging material comprises jetting ink through an inkjet printhead onto a surface of the packaging material.

9. A method according to claim 8, wherein the step of jetting ink through an inkjet printhead onto a surface of the packaging material comprises jetting a UV-reactive ink onto a surface of the packaging material.

10. A method according to claim 9, further comprising the step of curing the UV-reactive ink, after the step of printing, by exposing the ink to UV light.

11. A method according to claim 1, further comprising the step of forming a container with the packaging material at the print site.

12. A method according to claim 11, wherein the step of digitally printing the digital image comprises printing the image substantially contemporaneously with the step of forming a container with the packaging material at the print site.

13. A method according to claim 12, wherein the step of digitally printing the image substantially contemporaneously with the step of forming a container with the packaging material at the print site comprises digitally printing the image adjacent to a form-fill-seal packaging machine.

14. A method according to claim 13, wherein the step of digitally printing the image adjacent to a form-fill-seal packaging machine comprises digitally printing the image within a form-fill-seal packaging machine.

15. A method according to claim 1, wherein the step of transferring the digital image to a printing site comprises electronically transmitting the digital image to the printing site.

16. A method according to claim 1, wherein the step of transferring the digital image to a printing site comprises electronically transmitting the digital image to the printing site via telephone modem.

17. An apparatus for printing directly onto packaging material, the apparatus comprising the following:

means for generating an electronically storable and retrievable digital image;

means for transferring the digital image to a printing site; and

means for digitally printing the digital image directly onto packaging material at the printing site.

18. A method of printing directly onto packaging material comprising the following steps:

generating an electronically transmissible image at a first location;

transmitting the image to a packaging material production site remote from the first location;

receiving the image at the packaging material production site; and

transferring the image onto packaging material.

19. An apparatus for printing graphic information onto packaging material, the apparatus comprising the following:

a digitally controlled printhead; and

means for moving material past the printhead.

20. An apparatus according to claim 19, further comprising the following:

a supply of curable ink in fluid communication with the printhead; and

a source of curing radiation in proximity with th packaging material.

21. An apparatus according to claim 20, wherein the supply of curable ink comprises UV-reactive ink, and the source of curing radiation comprises a UV light source.

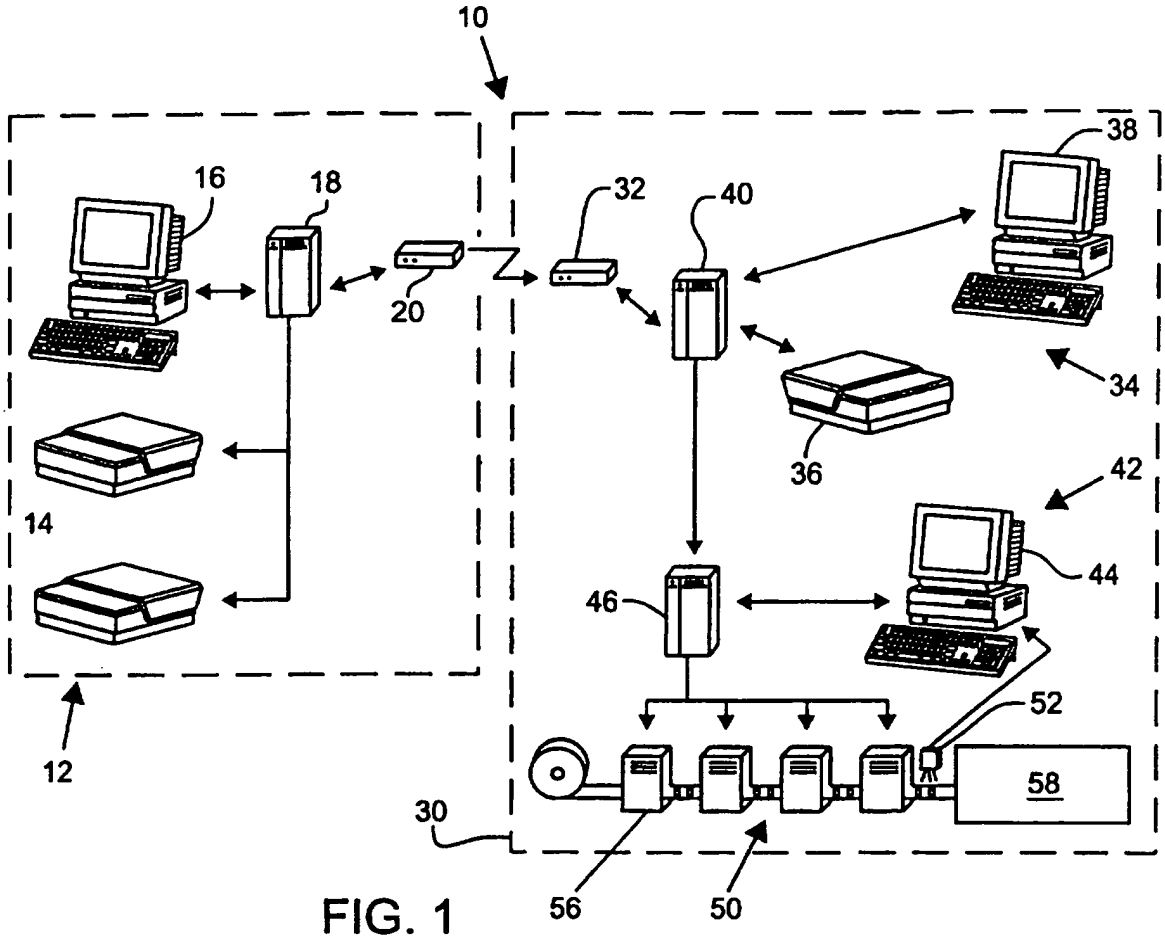


FIG. 1

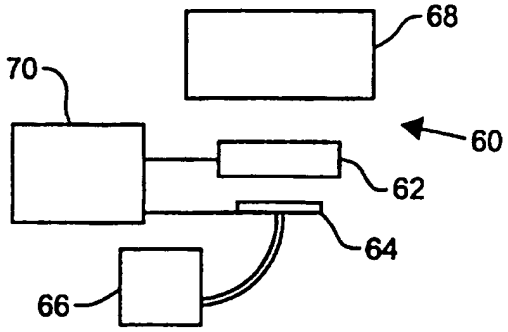


FIG. 2

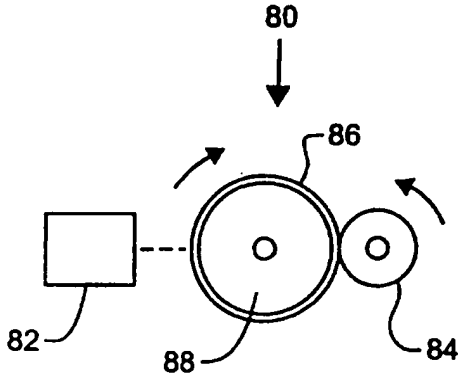


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/01283

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B41F 17/00
US CL : 101/35; 493/187

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 101/35; 493/187,186,188,320,321,322,323,324,325

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,423,617 A (MARSH et al) 13 JUNE 1995, col. 4, lines 40-68.	1,4-8 and 11-19
Y, P	US 5,570,632 A (CUMENS et al) 05 NOVEMBER 1996, cols. 1-2.	2-3
Y	US 5,328,438 A (CROWLEY) 12 JULY 1994, cols 5-7.	1,4-8. and 11-19
Y	US 5,237,917 A (TRAUT et al) 24 AUGUST 1993, cols. 2-4.	1,4-10 and 11-21

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 05 MAY 1997	Date of mailing of the international search report 02 JUN 1997
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer STEVEN KELLEY Telephone No. (703) 308-0979

Form PCT/ISA/210 (second sheet)(July 1992)*